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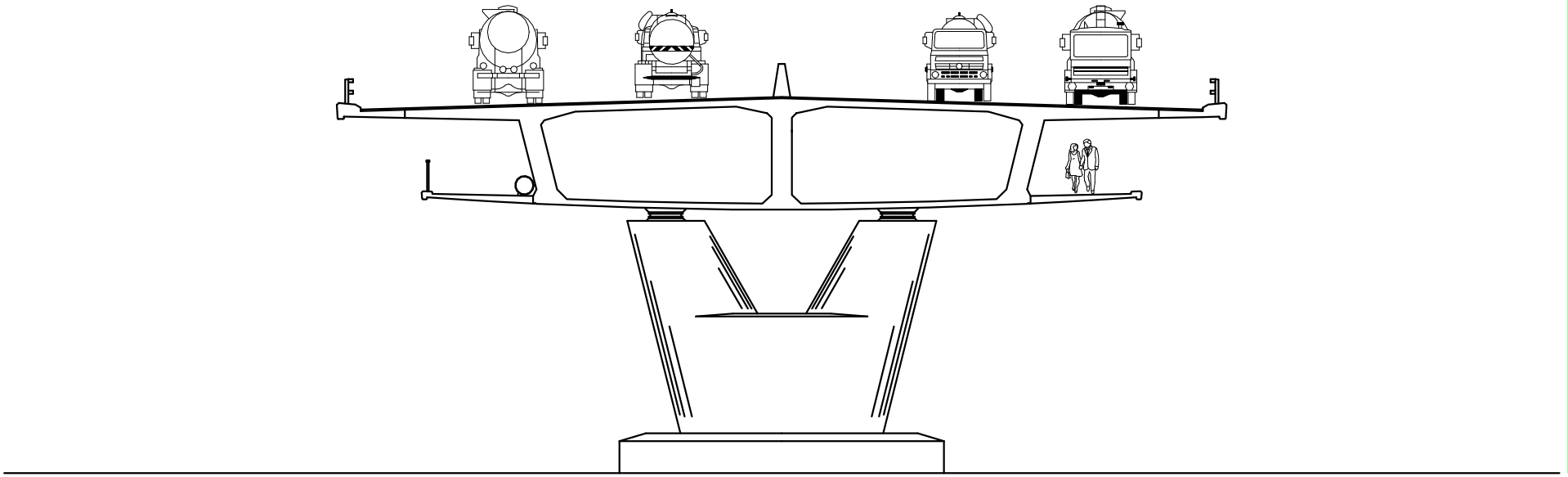
Constructing the New Mt Henry Bridge, and Strengthening the Old Mt Henry Bridge

Talk presented by Joe Wyche, Director, Wyche Consulting
Institution of Engineers Australia, Perth WA
17 April 2007



LAND BOUNDARY AT ABUTMENT

ORIGINAL BRIDGE

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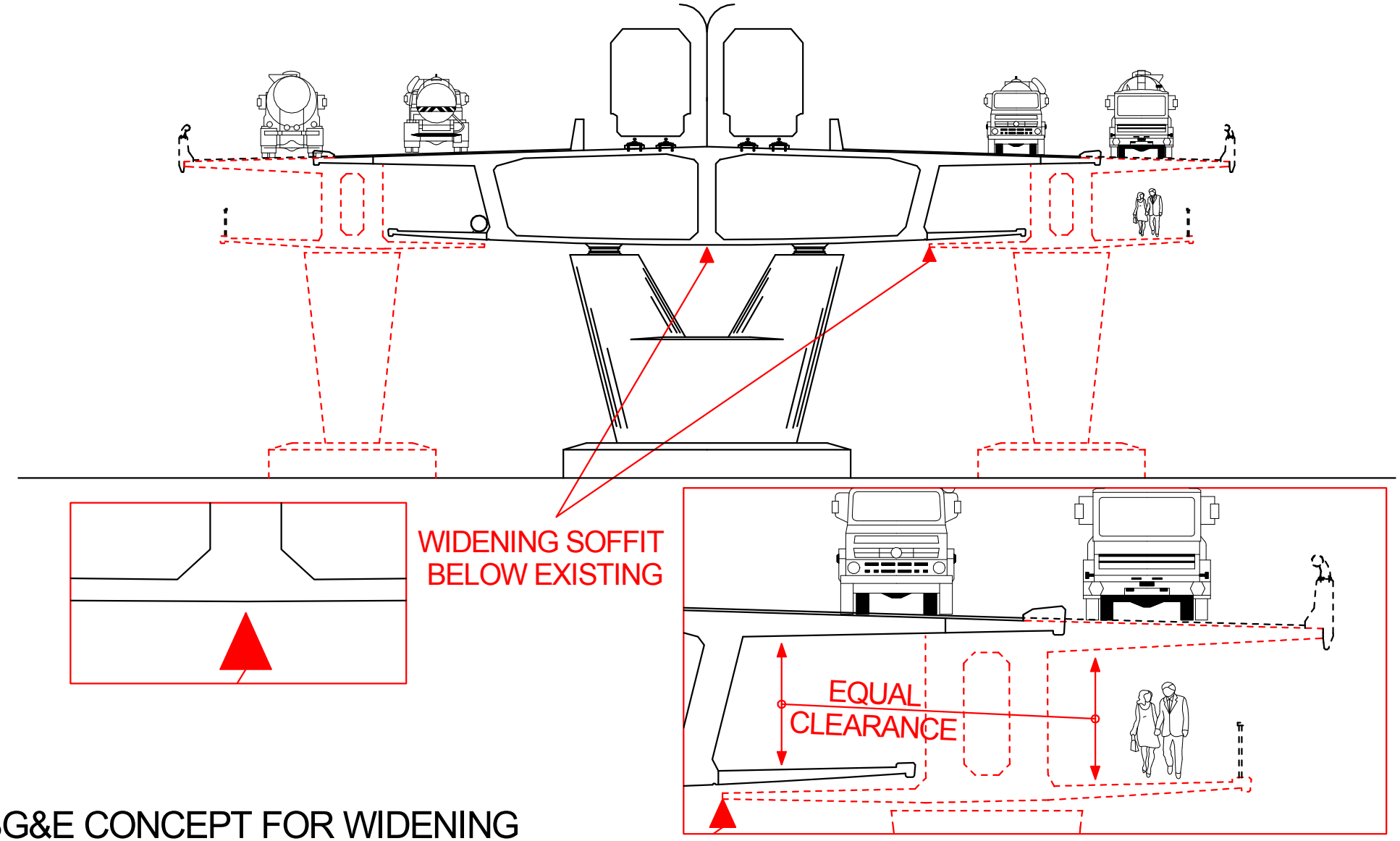

BG&E CONCEPT FOR WIDENING

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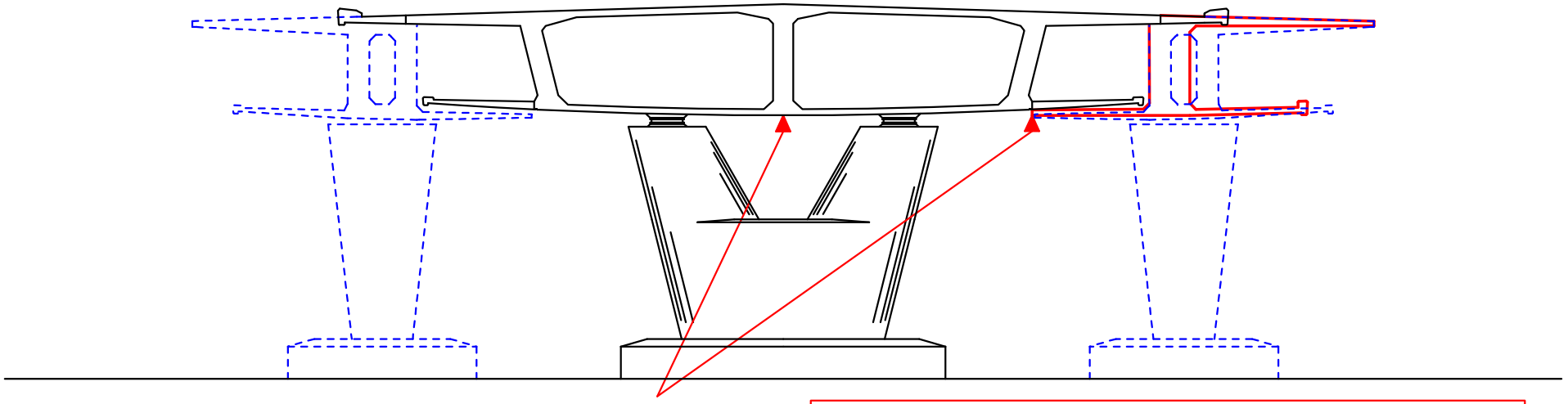
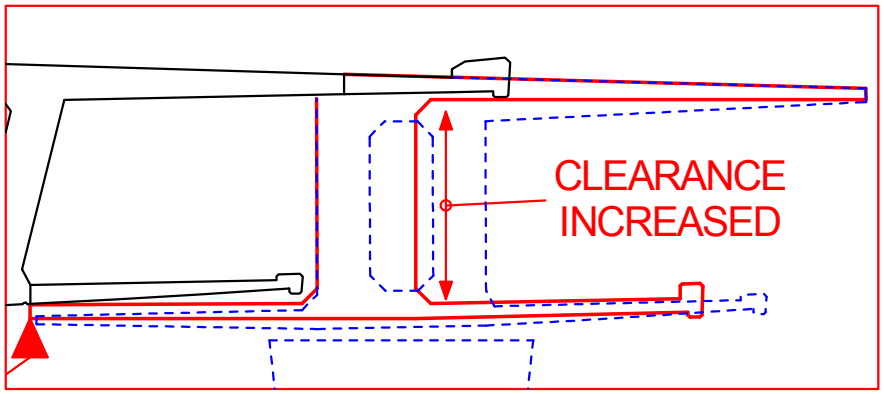
LAND BOUNDARY AT ABUTMENT



WIDENING SOFFIT NOT
BELOW EXISTING



- CANTILEVERS TOO THIN
- TIGHT BELOW SOFFIT

SCOPE OF WORKS CONSTRAINTS

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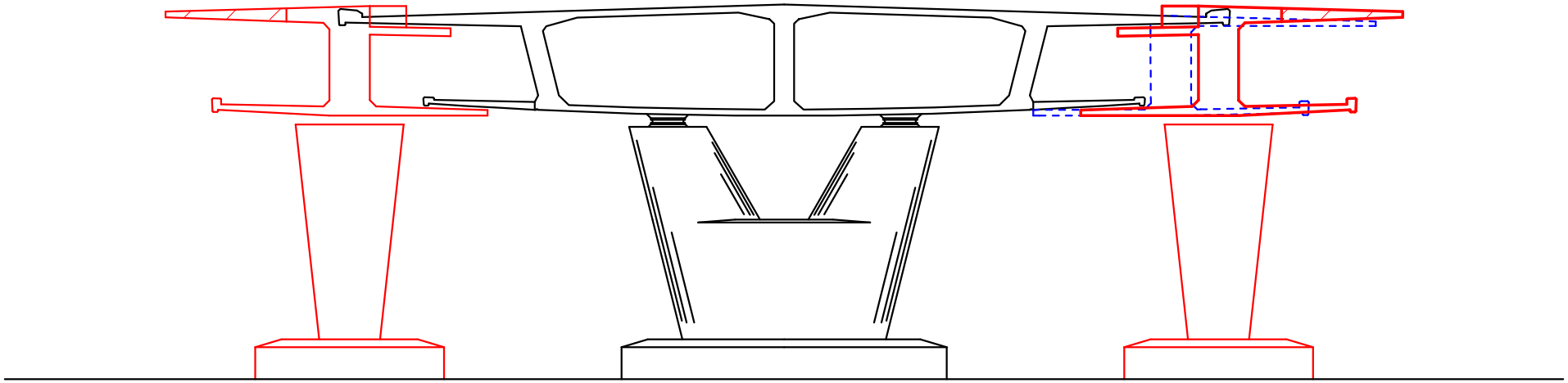
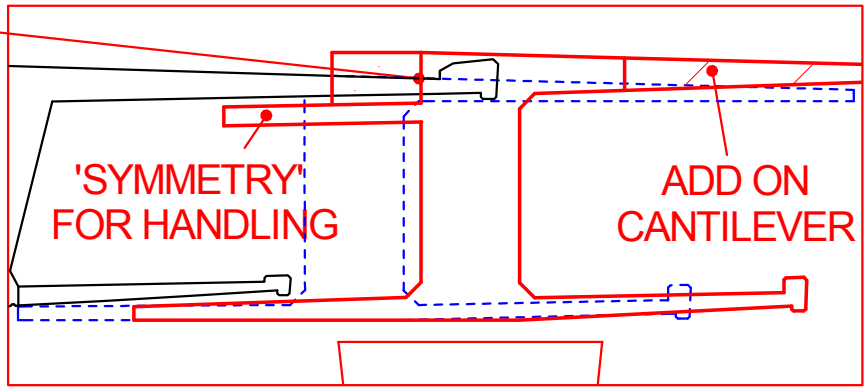


INCREASE SECTION HEIGHT
AND 'STITCH' INFILL

- SHIFT OUTWARDS, BETTER SOFFIT CLEARANCE
- CONSTRUCTION PROGRAM DIFFICULT



TO IMPROVE CANTILEVER DEPTH

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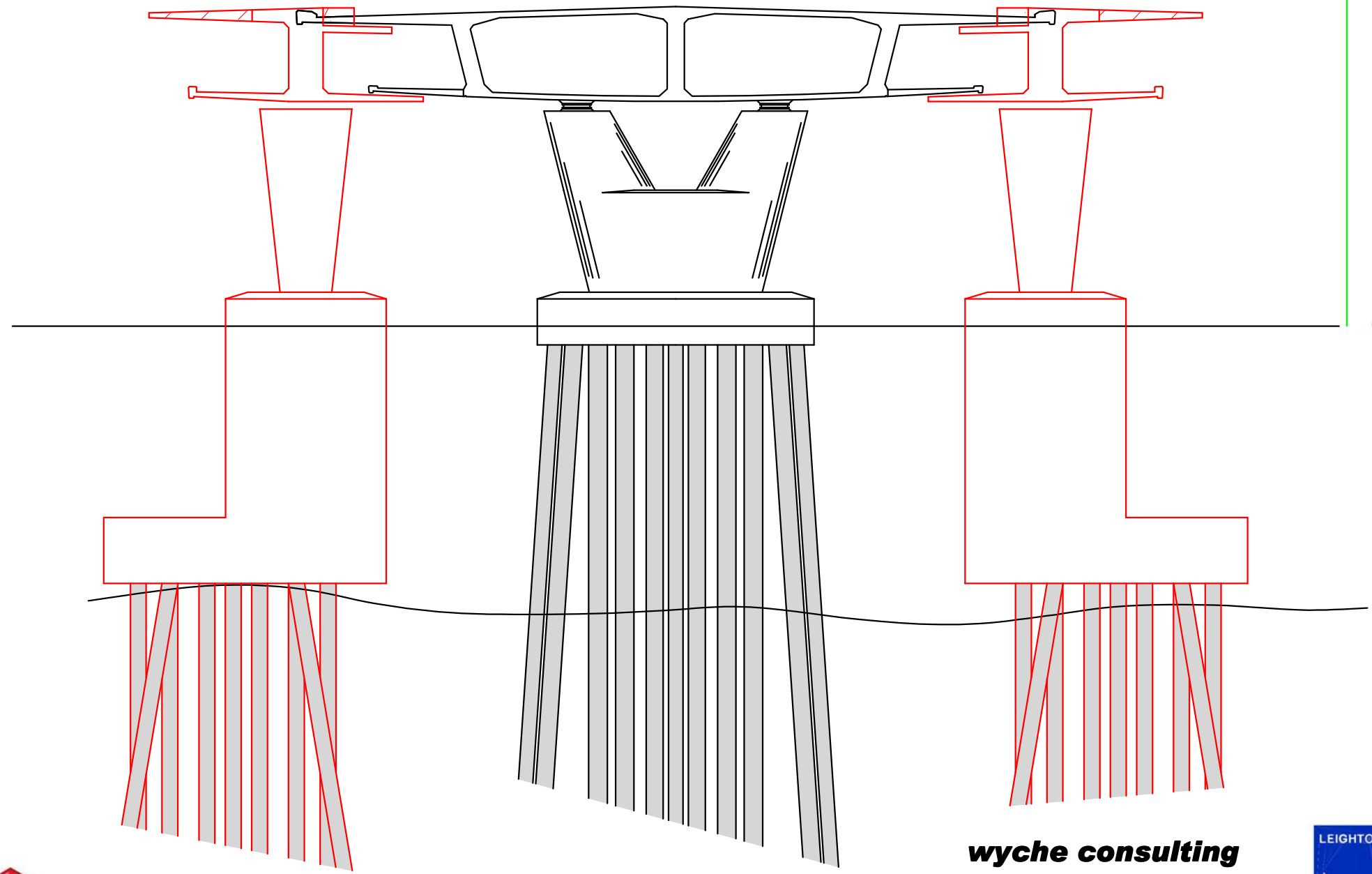

AN INTERESTING PILECAP

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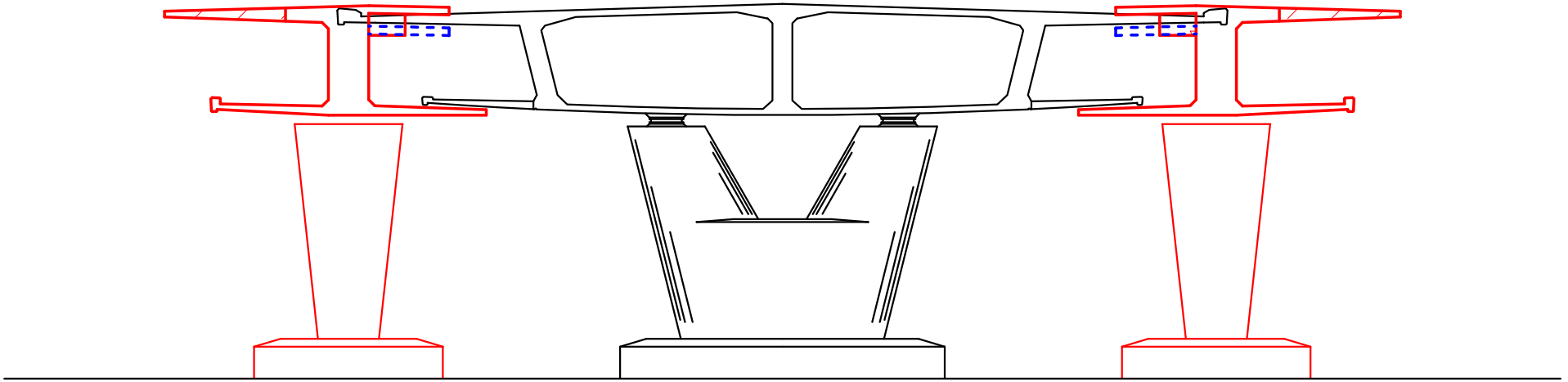
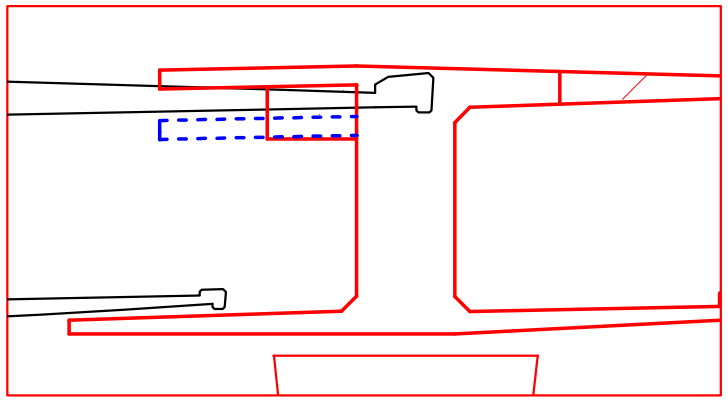


LAND BOUNDARY AT ABUTMENT



BETTER TO PLACE
SYMMETRY CANTILEVER
ABOVE

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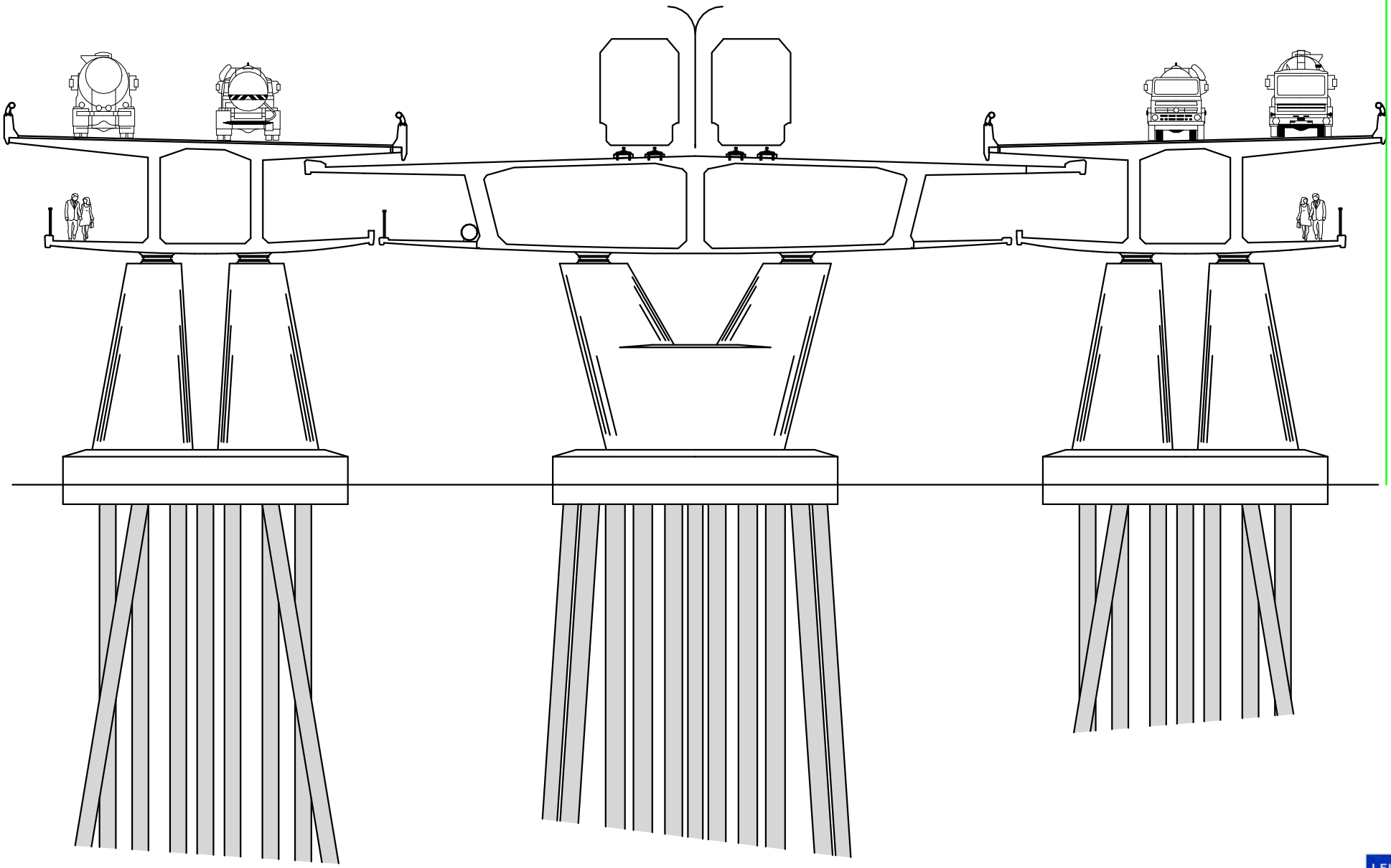

LAND BOUNDARY AT ABUTMENT

AN ESSENTIALLY CONFORMING SOLUTION

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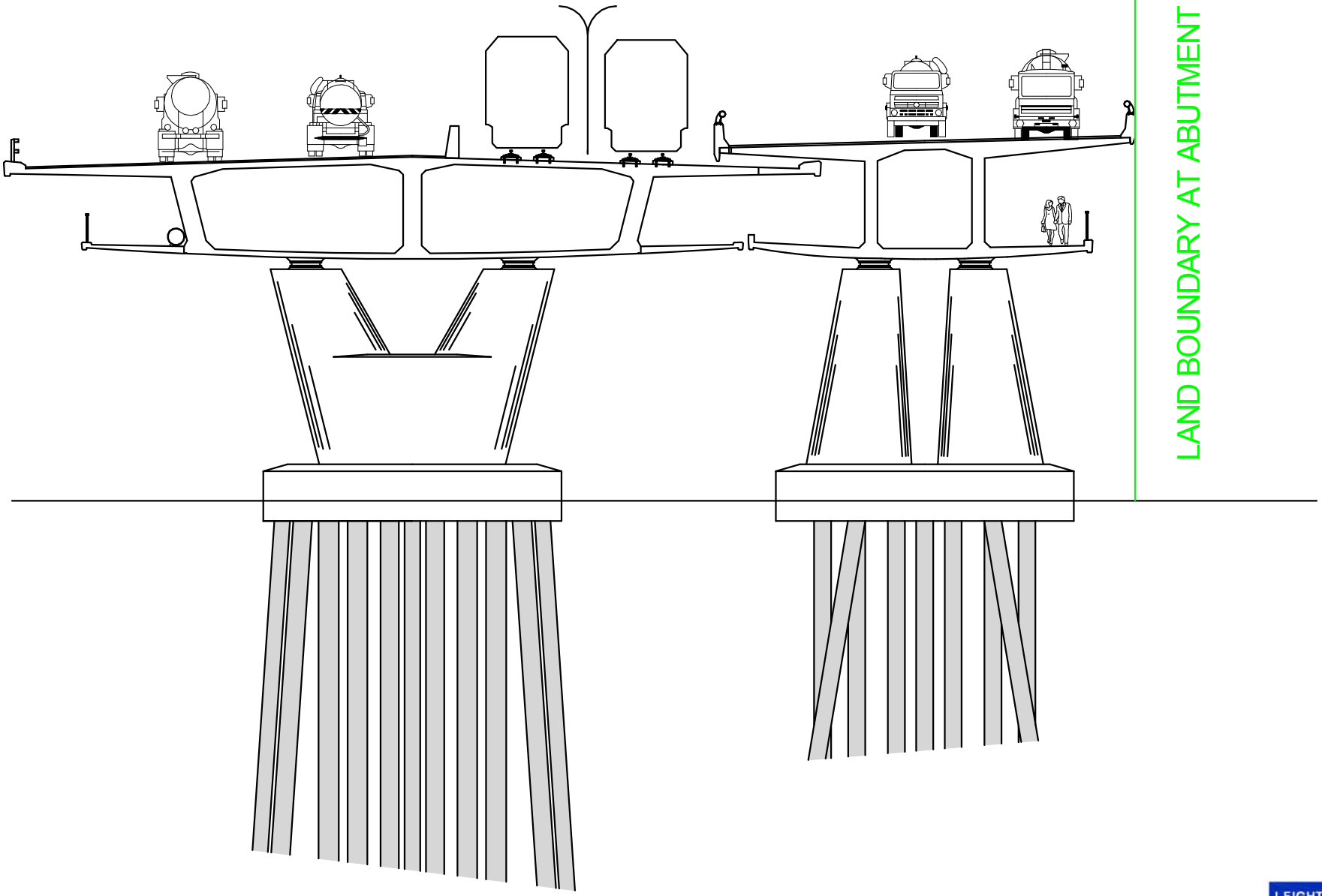

ALTERNATIVE
WITH ONE BRIDGE

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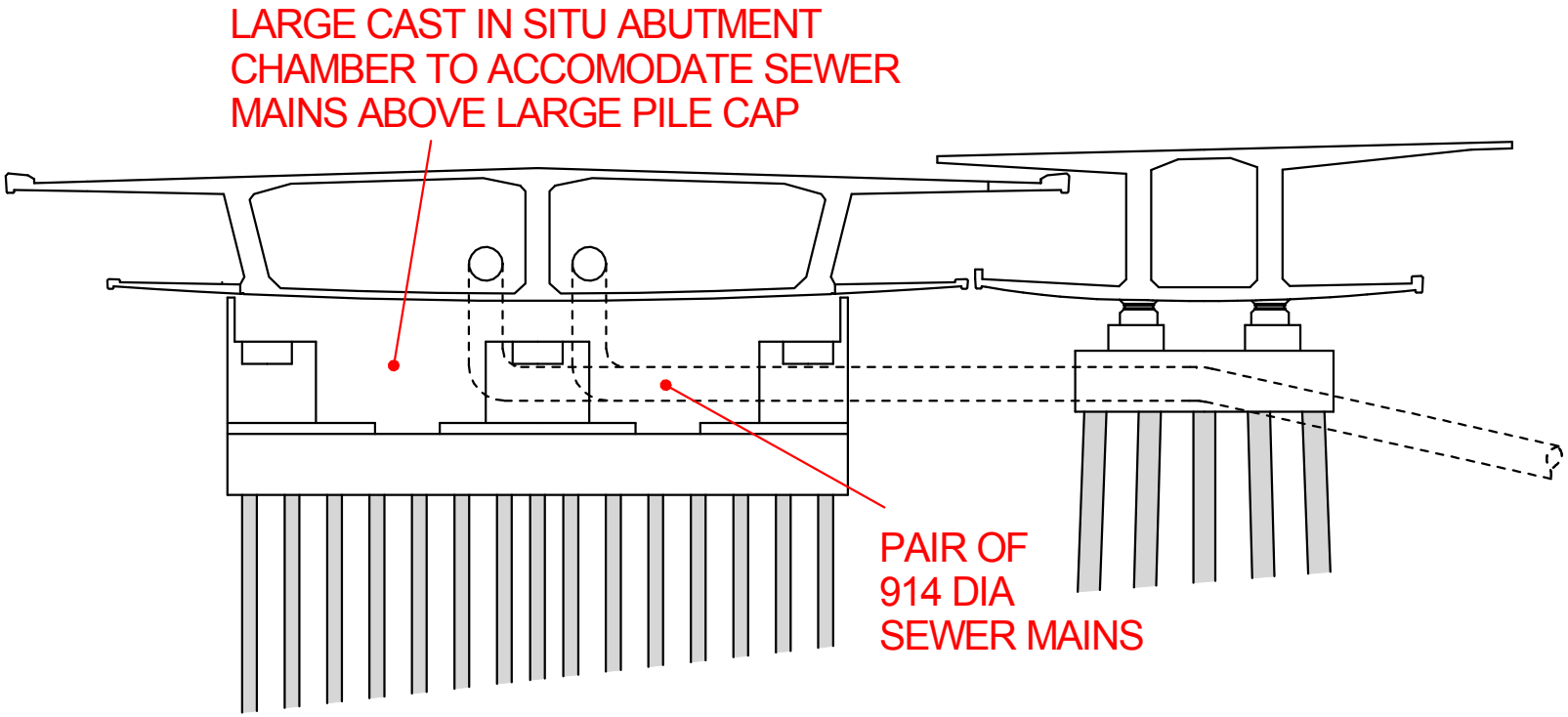

SECTION THROUGH EXISTING AND NEW BRIDGE
AT SOUTH ABUTMENT

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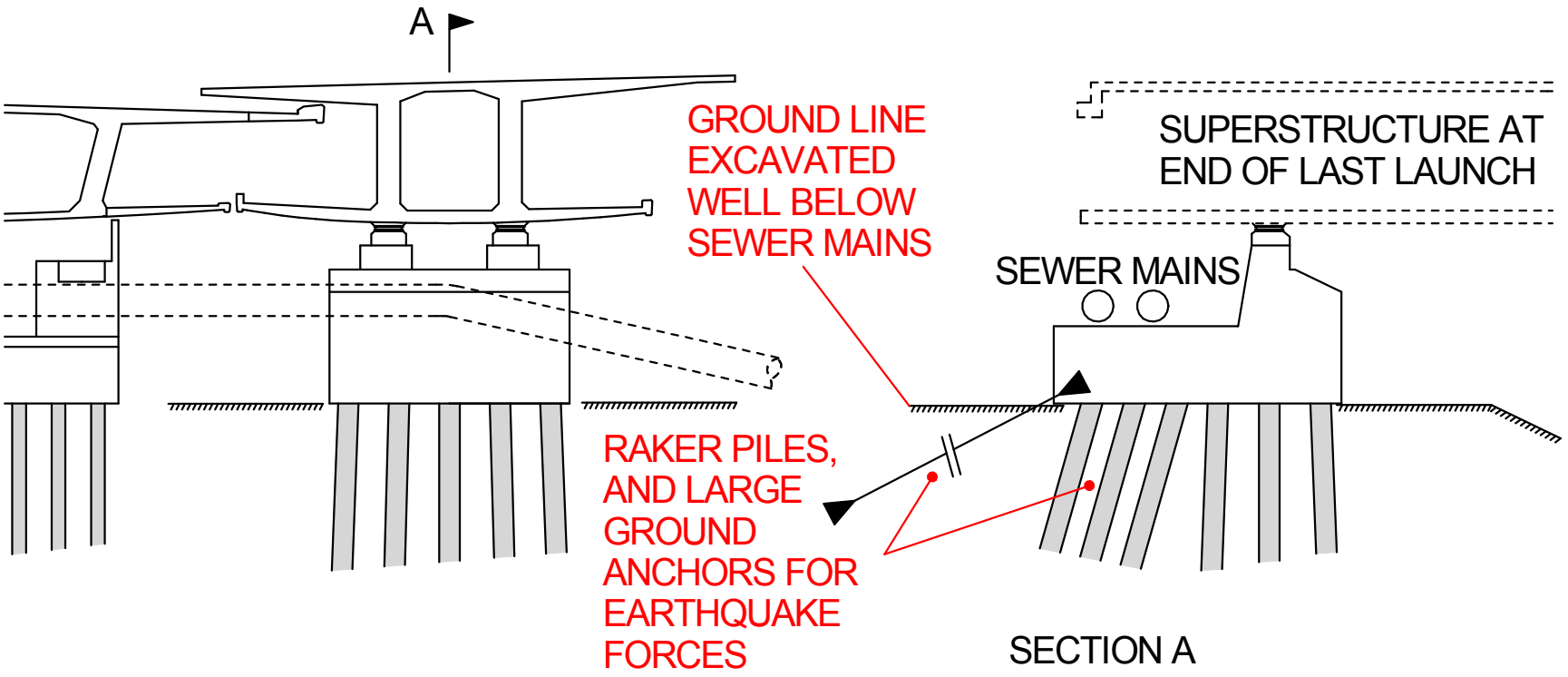
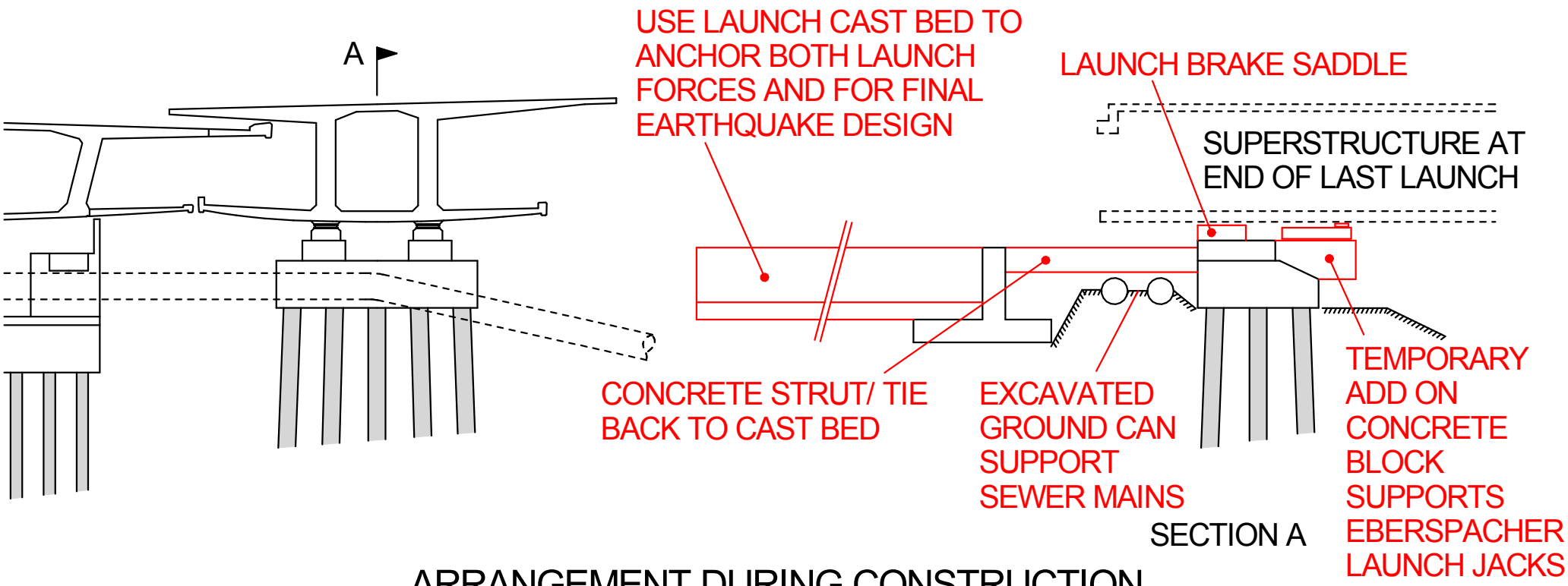
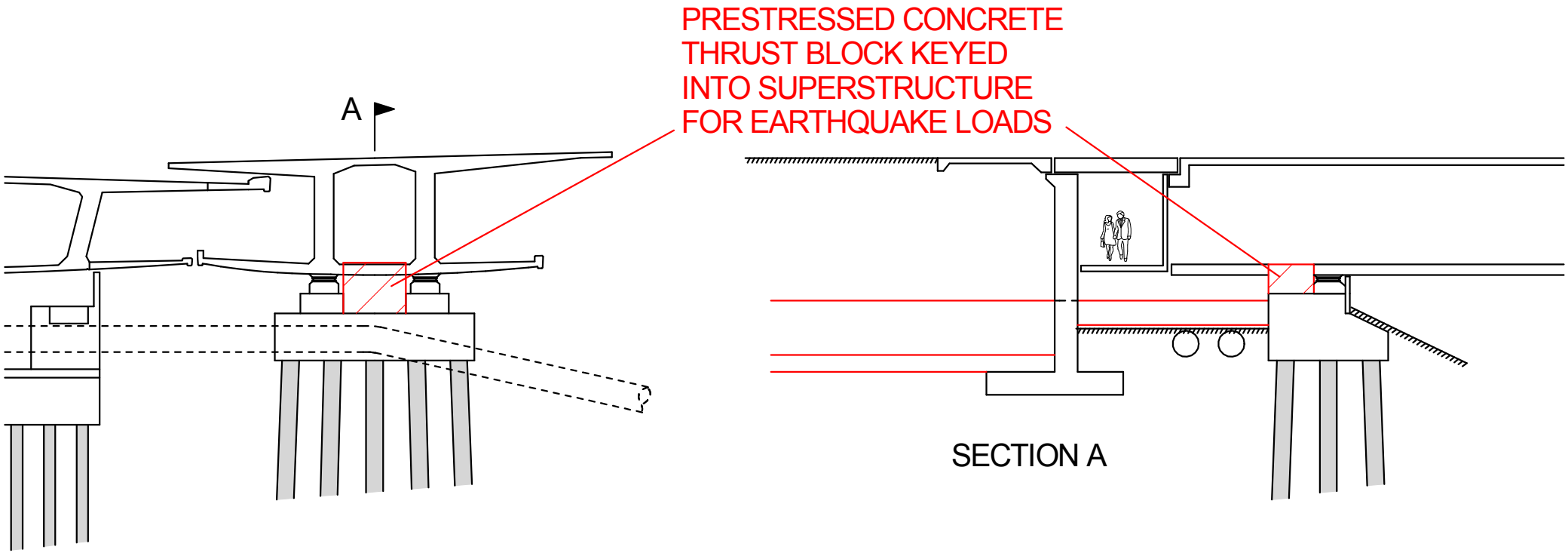


DIFFICULT TO ADOPT SIMILAR ARRANGEMENT TO EXISTING BRIDGE



ARRANGEMENT DURING CONSTRUCTION



FINAL ARRANGEMENT WITH BURIED CAST BED FOR ANCHOR

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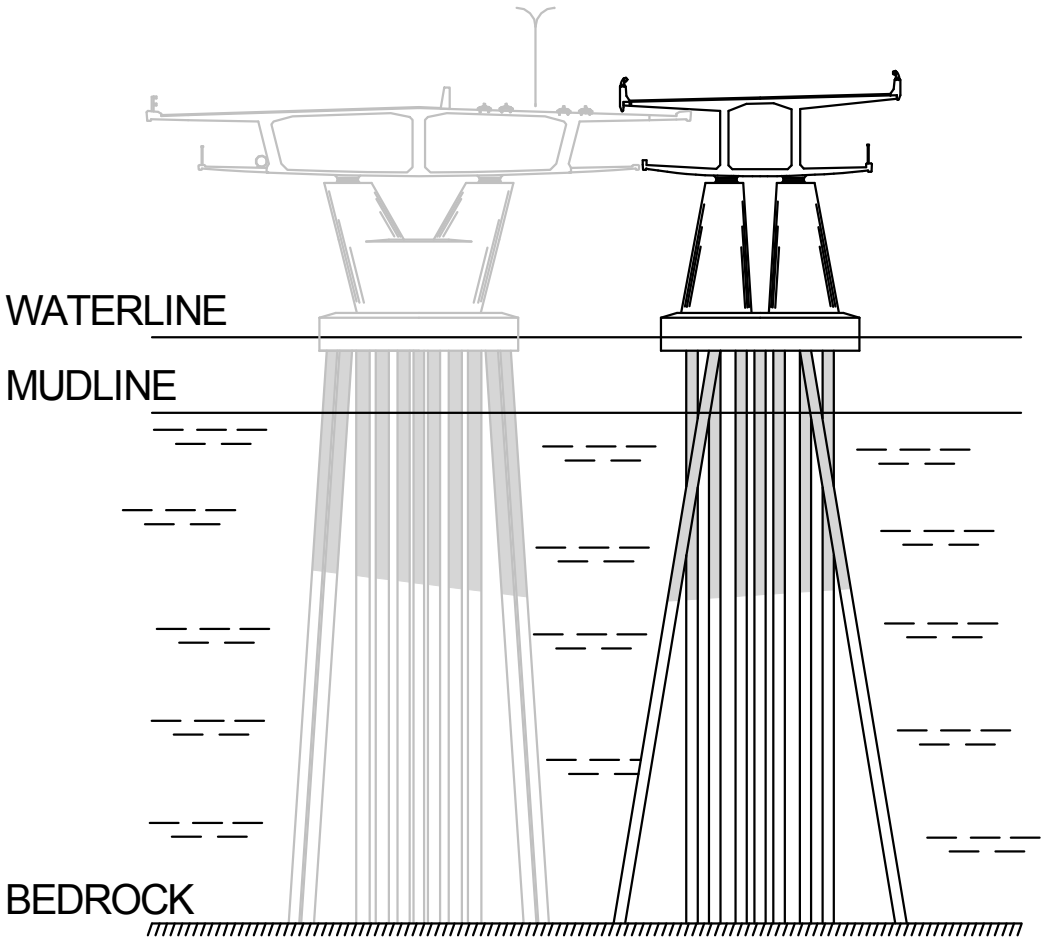

PILES MUST BE RESTRAINED
LATERALLY BY VERY SOFT MUD
ABOUT 27M DEEP

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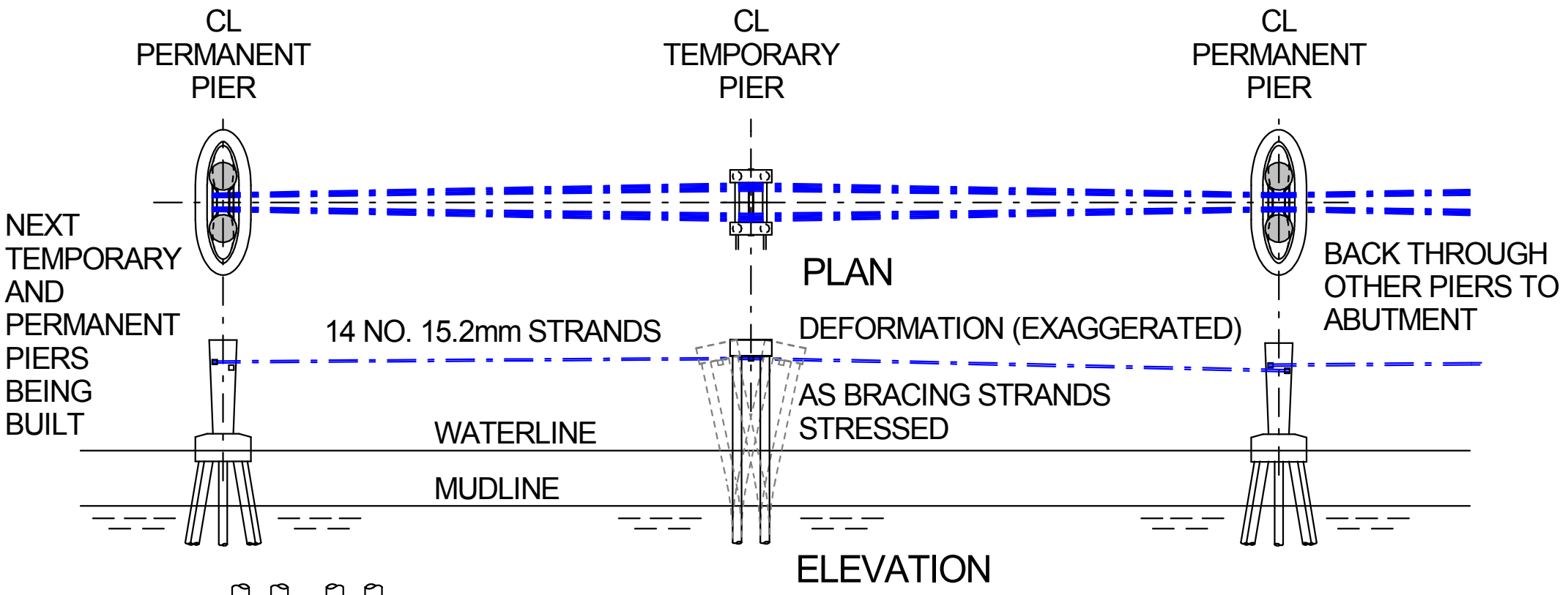
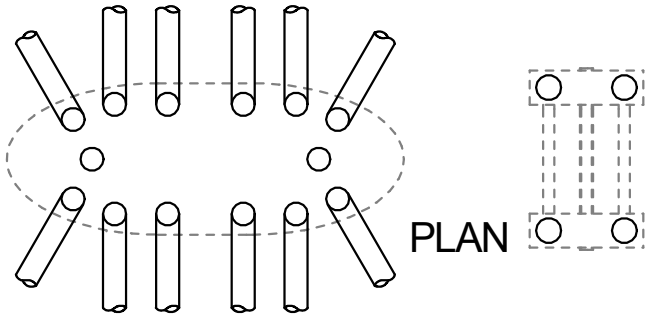
NOTE FOUR PILES ON TEMPORARY PIER AT HALF OF EACH 76M SPAN. THERE ARE AT LEAST 14 PILES ON PERMANENT PIERS.





COMPARE STIFFNESS OF 14 OR MORE PILES AND CONCRETE PERMANENT PIER TO 4 PILE TEMPORARY PIER

HORIZONTAL LONGITUDINAL BRACING FOR TEMPORARY PIER STABILITY

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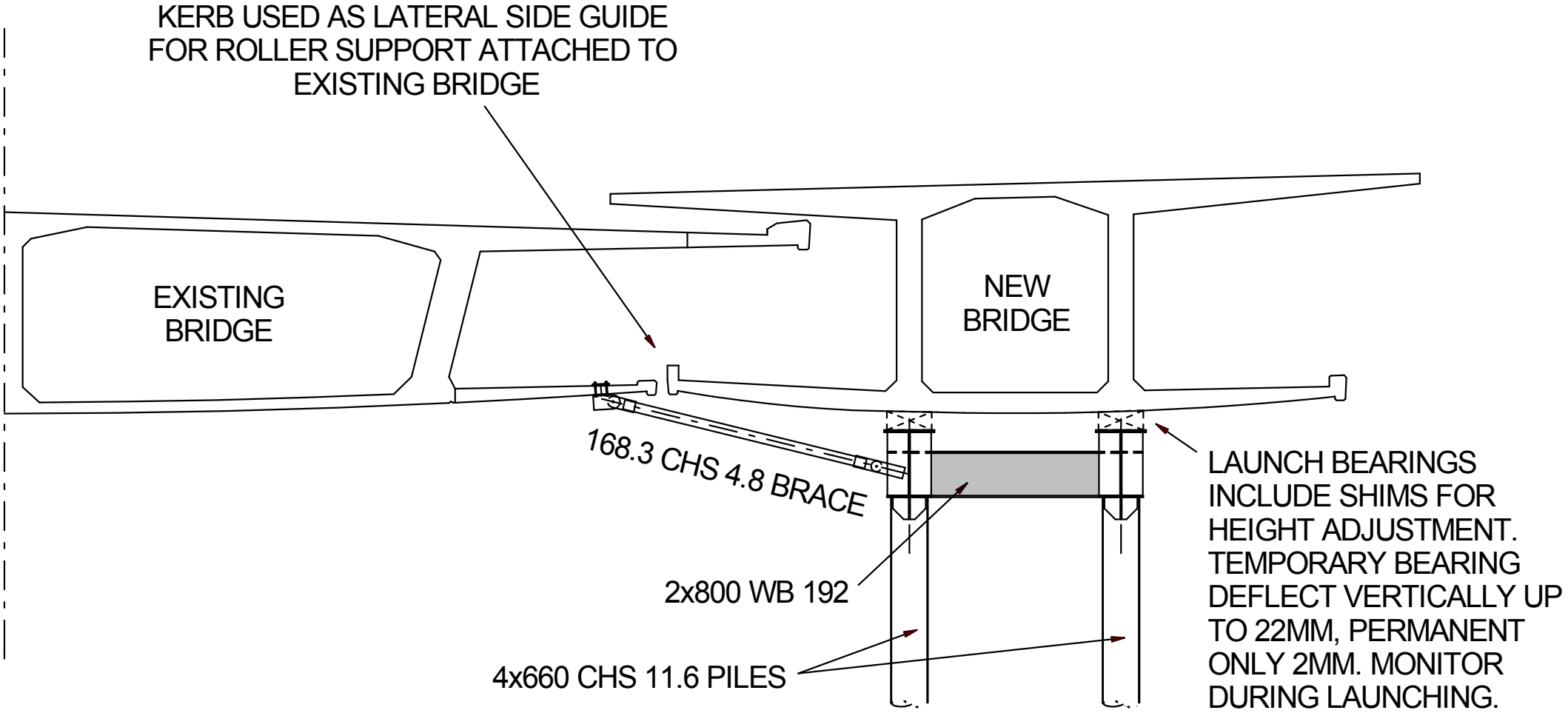

SOME FEATURES OF TEMPORARY PIER AND LAUNCHING CONTROL

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ROLLER SIDE GUIDE HOOKED OVER LOWER FLANGE KERB

TEMPORARY PIER AND BRACING

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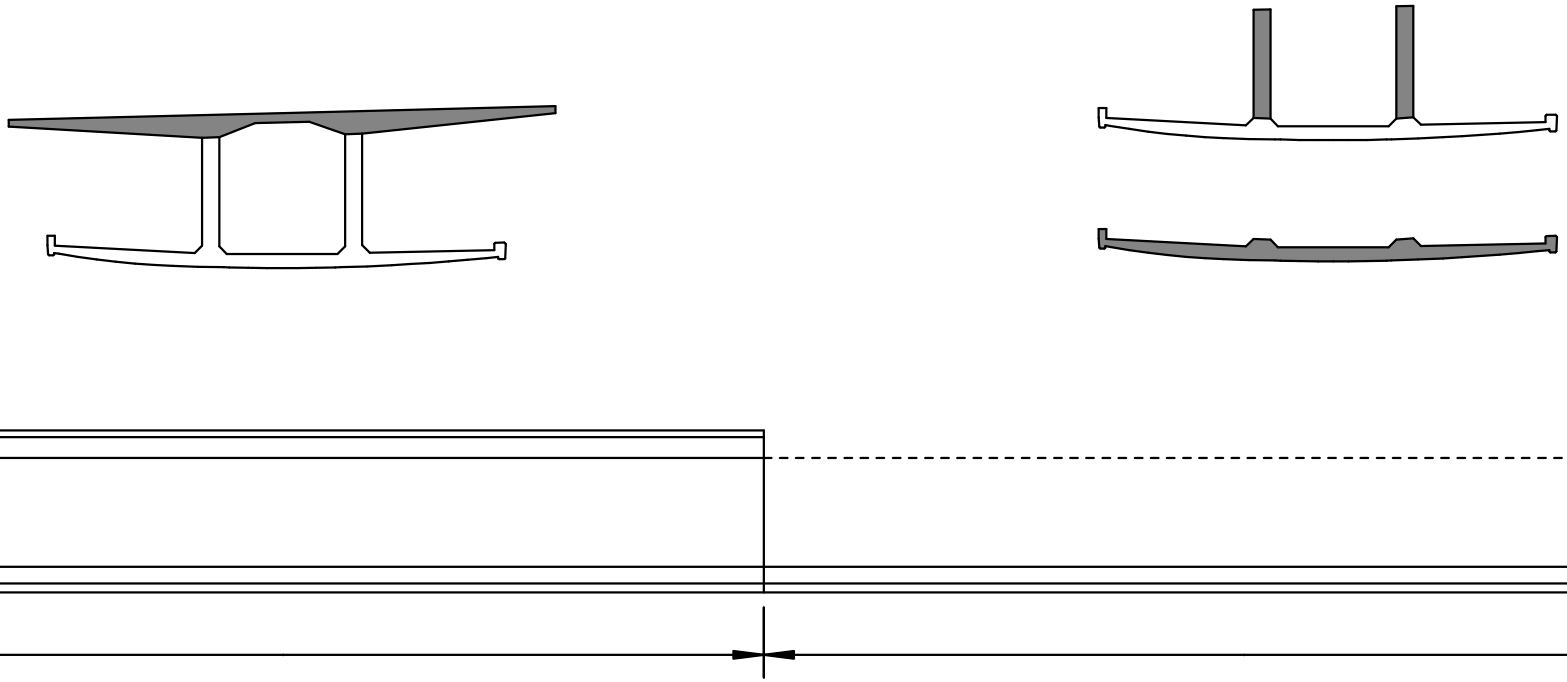

FRONT CAST BED WITH SPECIAL SCAFFOLDING TO LOWER CANTILEVER FORMS. TOP DECK CAST IN SAME CYCLE AS REAR LOWER FLANGE AND WEBS

REAR CAST BED FOR LOWER FLANGE ON ARCHITECTURAL FORMS, THEN WEB. FORMS LOWERED ON TRANSVERSE BEAM GRILLAGE.

7 TO 10 DAY LAUNCH CYCLE

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Top 3 photos

1. CAST BED WITH SUPPORT GRILLAGE IN REAR
2. LOWER FLANGE 1ST SEGMENT
3. AFTER FIRST LAUNCH

Lower 2 photos

4. PREPARE REAR LOWER AND FRONT UPPER CAST.
5. LIFTING IN REAR RF CAGE.

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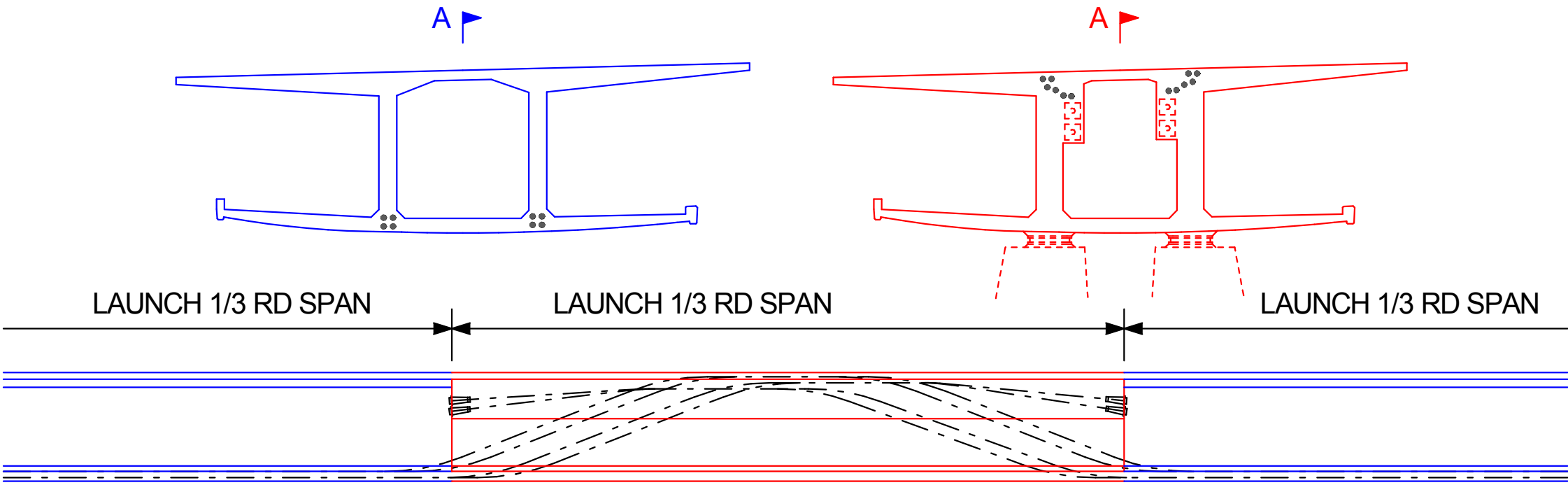
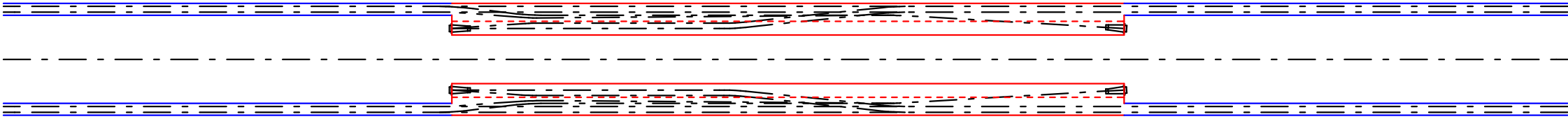


SECTIONAL ELEVATION A



PLAN ON WEBS

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LOOKING ALONG THE BRIDGE
INSIDE THE BOX GIRDER

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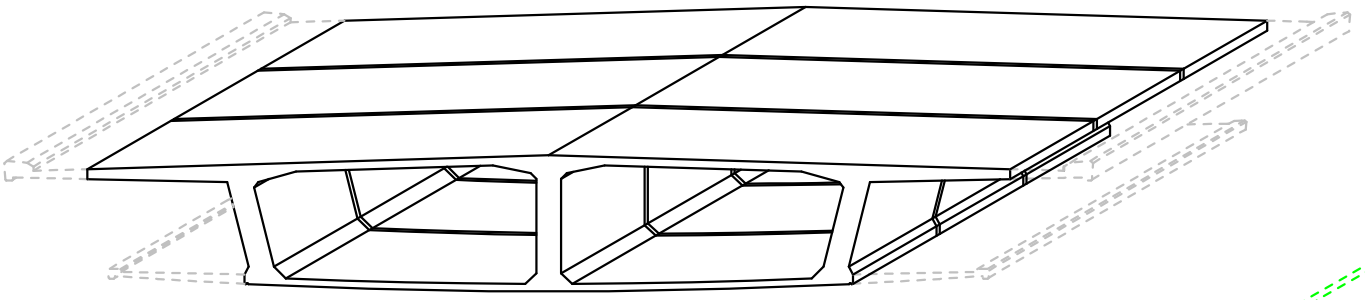

2550MM LONG SEGMENTS STRESSED TOGETHER WITH 100MM UNREINFORCED WET JOINT, THEN CANTILEVERS ADDED. NO NET TENSION ALLOWED FOR TRAIN SERVICEABILITY LOADS.

ALTHOUGH ULTIMATE RAIL LOADS SAME AS ORIGINAL DESIGN LOADS, FLEXURAL, WEB SHEAR AND SUSPENSION DEFICIENCY AT WEB JOINS TO TRANSVERSE DIAPHRAGMS. SEWER PIPES MAKE ACCESS FOR IMPROVEMENT DIFFICULT.

IMPROVEMENTS NEEDED FOR EXISTING BRIDGE

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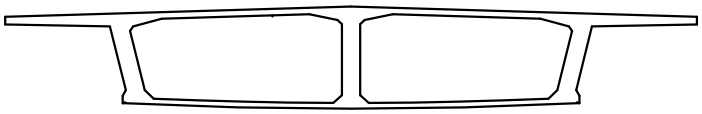
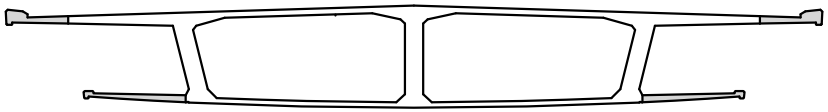
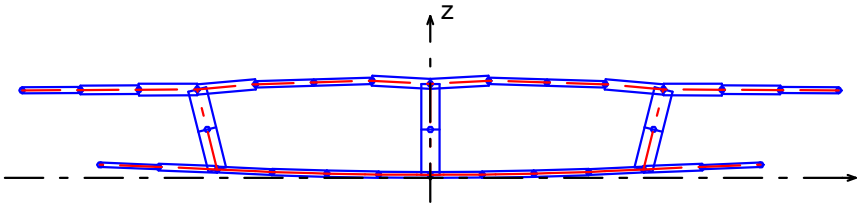


BRIDGE ANALYSED FOR SPAN BY SPAN CONSTRUCTION STAGING EFFECTS, UP UNTIL CANTILEVERS ADDED. THE ADDITION OF PRESTRESS BEFORE ADDING THE CANTILEVERS IS VERY BENEFICIAL IN PROVIDING SERVICEABILITY COMPRESSIVE STRESS.

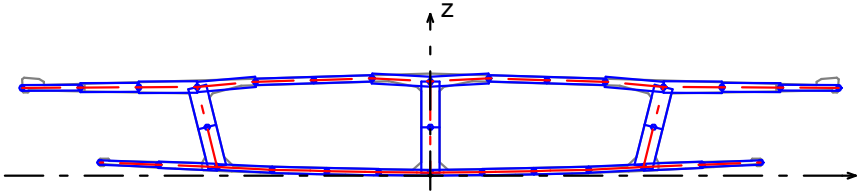


COMPLETED BRIDGE ANALYSED FOR SUBSEQUENT CREEP AND SHRINKAGE, SUPER DEAD LOAD AND IN SERVICE LOADS.

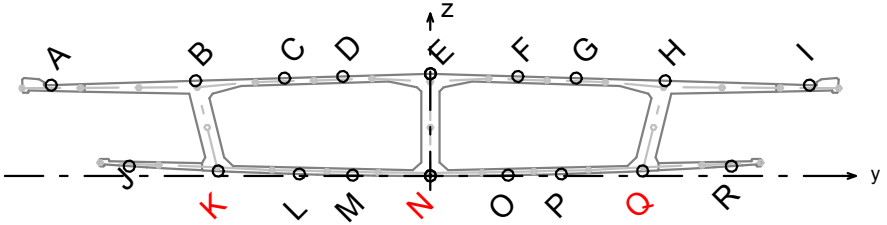
FINITE ELEMENT ANALYSIS TO DIRECTLY CALCULATE IN SERVICE STRESSES



FINITE ELEMENT MODEL USED
MODEL ALSO MODIFIED TO REMOVE CANTILEVERS



FE MODEL OVERLAID OVER SECTION



STRESS CHECK POINTS TENSILE STRESSES IN SERVICE AT K, N, Q OF OVER 2MPA IN SPAN 1, AND GENERALLY MUCH LESS THAN 1MPA IN OTHER SPANS. NOTE THAT WEB END STRESSES PROJECTED FROM WEB ELEMENT STRESSES, AND RECONCILED TO TOTAL MOMENT.

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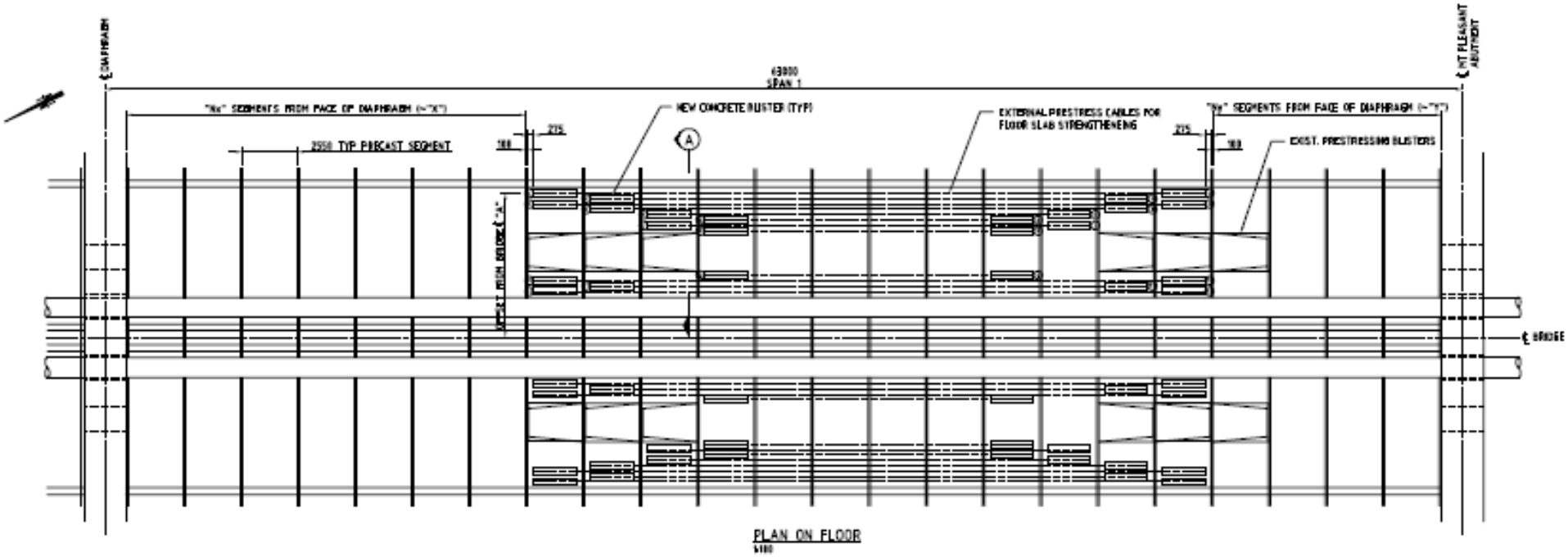
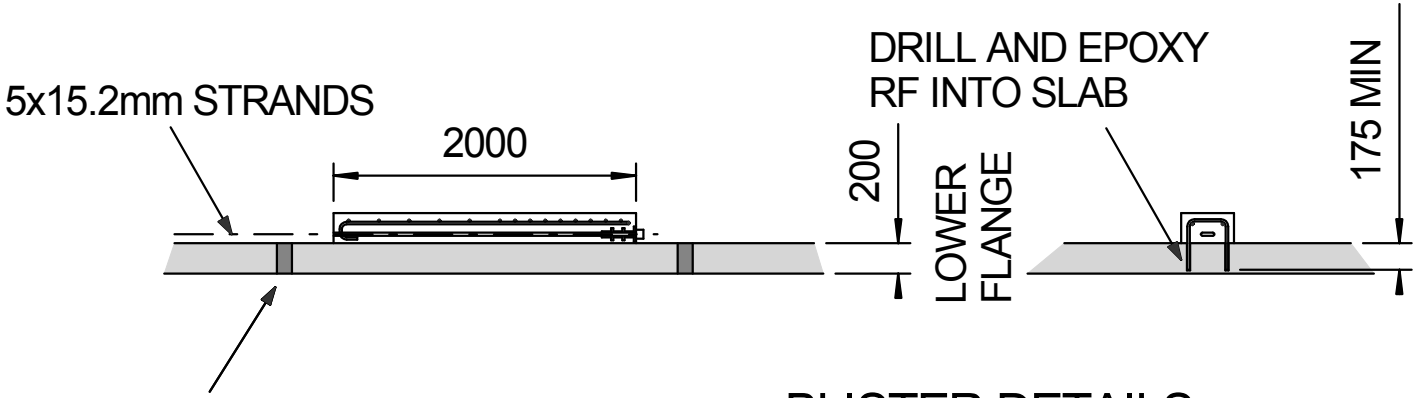
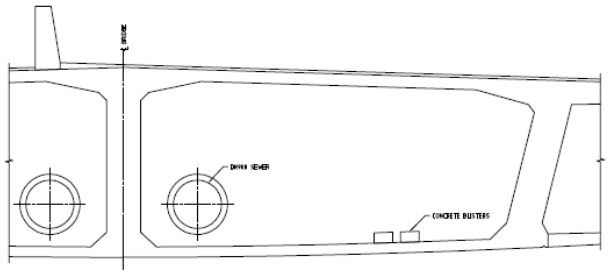


BLISTER PLAN SPAN 1 WHERE LESS INITIAL PS - OTHER SPANS GENERALLY HAVE ONLY 2 SETS PER CELL, OR AT THE MOST 4





BLISTER DETAILS
BASED ON ACI AND HILTI MANUAL

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EXTERNAL PRESTRESS FLOOR BLISTER

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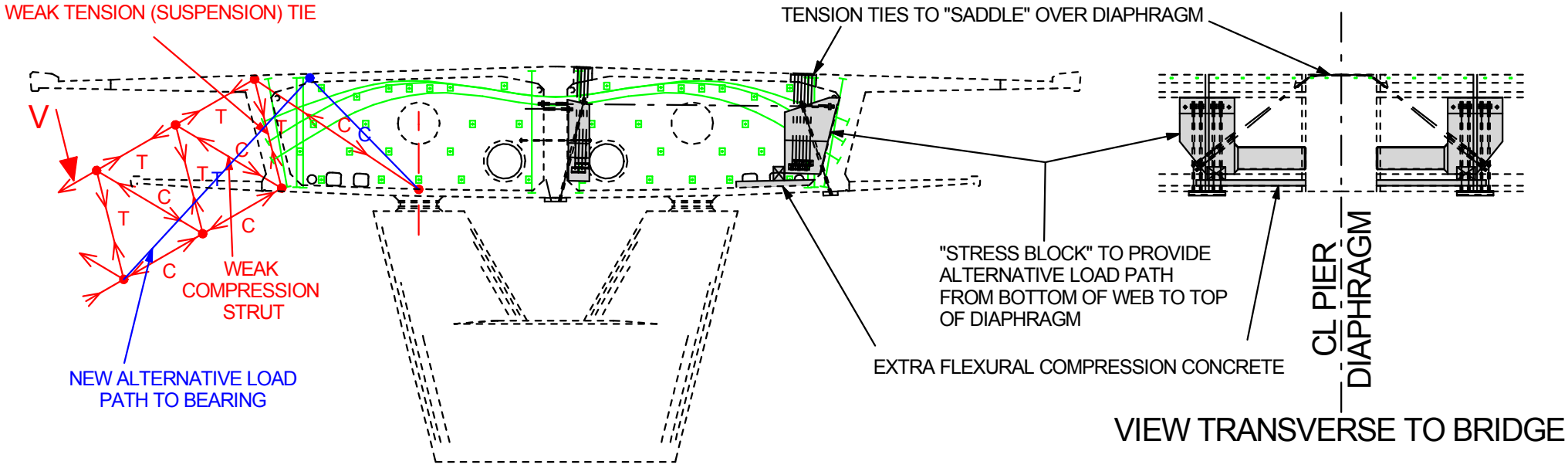

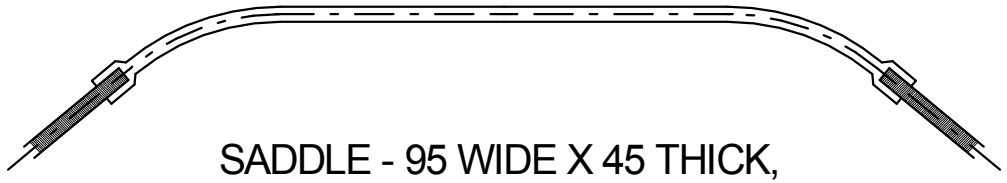

SADDLE - 95 WIDE X 45 THICK, WITH THREADED SOCKETS BUTT WELDED TO ENDS FOR 40MM STRESS BARS.

DESIGN/ CONSTRUCTION PROBLEMS
1. ANALYSIS 3D SPACE FRAME MODEL. SEE WYCHE.COM.AU.
2. LOCATE AND AVOID PS AND RF IN WEBS WHEN CORING FOR STRESS BARS.
3. MUST PRESTRESS STRESS BARS TO PROVIDE STIFFNESS COMPATIBILITY.
4. FITTING INTERFACE SHEAR STEEL FOR FLEXURAL COMPRESSION CONCRETE INTO BOTTOM OF WEB.

FLEXURE/ SHEAR/ SUSPENSION STRENGTHENING

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EXTRA FLEXURAL CONCRETE

STRESS BLOCK REINFORCEMENT

STRESS BARS TO SADDLES

FINISHING BELOW SADDLES

SADDLES UP ON DECK BEFORE COVERING

CONCRETE STRESS BLOCK OUTER WEB

CONCRETE STRESS BLOCK INNER WEB BEHIND SEWER PIPE

FLEXURE/ SHEAR/ SUSPENSION STRENGTHENING

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